1    **WHAT IS CLAIMED IS:**

1        1. An interferometery system for making interferometric measurements of an

2    object, said system comprising:

3        a beam generation module which during operation delivers an output beam that

4    includes a first beam at a first frequency and a second beam at a second frequency that is

5    different from said first frequency, said first and second beams within the output beam

6    being coextensive, said beam generation module including a beam conditioner which

7    during operation introduces a sequence of different shifts in a selected parameter of each

8    of the first and second beams, said selected parameter selected from a group consisting of

9    phase and frequency;

10        a detector assembly having a detector element; and

11        an interferometer constructed to receive the output beam at least a part of which

12    represents a first measurement beam at the first frequency and a second measurement

13    beam at the second frequency, said interferometer further constructed to image both the

14    first and second measurement beams onto a selected spot on the object to produce

15    therefrom corresponding first and second return measurement beams, and to then

16    simultaneously image the first and second return measurement beams onto said detector

17    element.

1        2. The interferometer system of claim 1 wherein the beam generation module

2    further comprises a beam source which during operation generates a single input beam at

3    a predetermined frequency, and wherein the beam conditioner comprises an optical

4    element that derives the first and second beams from the single input beam.

1        3. The interferometer system of claim 2 wherein said optical element is an

2    acousto-optic modulator.

1        4. The interferometer system of claim 1 wherein each of said first and second

2    beams includes a first component and a second component that is orthogonal to the first

3    component, and wherein the beam conditioner is constructed to introduce a first sequence

4    of different discrete phase shifts into a relative phase difference between the first and

5    second components of the first beam and concurrently therewith a second sequence of

6    different discrete phase shifts into the relative phase difference between the first and

7    second components of the second beam.

1        5. The interferometer system of claim 4 wherein the beam conditioner includes a

2    first phase shifter for introducing the first sequence of different discrete phase shifts into

3    the relative phase difference between the first and second components of the first beam

4    and a second phase shifter for introducing the second sequence of different discrete phase

5    shifts into the relative phase difference between the first and second components of the

6    second beam.

1        6. The interferometer system of claim 4 wherein the interferometer is

2    characterized by a measurement beam optical path length and a reference beam optical

3    path length and wherein the difference between those two optical path lengths is

4    nominally zero.

1        7. The interferometer system of claim 4 wherein the interferometer is constructed

2    to generate the first measurement beam from the first component of the first beam and the

3    second measurement beam from the first component of the second beam.

1        8. The interferometer system of claim 7 wherein the interferometer is further

2    constructed to generate a first reference beam from the second component of the first

3    beam and a second reference beam from the second component of the second beam.

1        9. The interferometer system of claim 8 wherein the first phase shifter introduces

2    the first sequence of different discrete phase shifts into the second component of the first

3    beam and the second phase shifter introduces the second sequence of different discrete

4    phase shifts into the second component of the second beam.

1        10. The interferometer system of claim 1 wherein the beam conditioner is

2    constructed to introduce a first sequence of different frequency shifts into the frequency

3    of the first beam and concurrently therewith a second sequence of different frequency

4    shifts into the frequency of the second beam.

1        11. The interferometer system of claim 10 wherein the beam conditioner includes

2    a first set of acousto-optic modulators for introducing the first sequence of different

3    frequency shifts into the frequency of the first beam and a second set of acousto-optic

4    modulators for introducing the second sequence of different frequency shifts into the

5    frequency of the second beam.

1        12. The interferometer system of claim 10 wherein the interferometer is

2    characterized by a measurement beam optical path length and a reference beam optical

3    path length and wherein the difference between those two optical path lengths is

4    nominally a non-zero value.

1        13. The interferometer system of claim 1 further comprising a controller which

2    controls the beam conditioner and causes said beam conditioner to introduce the first and

3    second sequences of different shifts in the selected parameter of each of the first and

4    second beams.

1        14. The interferometer system of claim 13 wherein the controller is programmed

2    to acquire from the detector assembly measured values for a set of interference signals

3    resulting from introducing the first and second sequences of different shifts in the

4    selected parameters of each of the first and second beams and further programmed to

5    compute first and second components of conjugated quadratures of the fields of beams

6    from said selected spot.

1        15. The interferometer system of claim 11 wherein said detector element is

2    characterized by a frequency bandwidth and wherein the first and second frequencies are

3    separated by an amount that is larger than the frequency bandwidth of the detector.

1        16. The interferometer system of claim 1 wherein the interferometer is a scanning

2    interferometric far-field confocal microsope.

1        17. The interferometer system of claim 1 wherein the interferometer is a scanning

2    interferometric far-field non-confocal microsope.

1       18. The interferometer system of claim 1 wherein the interferometer is a scanning

2  interferometric near-field confocal microsope.

1       19. The interferometer system of claim 1 wherein the interferometer is a scanning

2  interferometric near-field non-confocal microsope.

1       20. The interferometer system of claim 1 wherein the interferometer is a linear

2  displacement interferometer.

1       21. An interferometery system for making interferometric measurements of an

2  object, said system comprising:

3       a beam generation module which during operation delivers an output beam that

4  includes a first beam at a first frequency and a second beam at a second frequency that is

5  different from said first frequency, said first and second beams within the output beam

6  being coextensive;

7       a detector assembly having a detector element that is characterized by a frequency

8  bandwidth, wherein the first and second frequencies are separated by an amount that is

9  larger than the frequency bandwidth of the detector; and

10      an interferometer constructed to receive the output beam, at least a part of which

11  represents within the interferometer a first measurement beam at the first frequency and a

12  second measurement beam at the second frequency, said interferometer further

13  constructed to simultaneously image both the first and second measurement beams onto a

14  selected spot on or in the object to produce therefrom corresponding first and second

15  return measurement beams, and then to simultaneously image the first and second return

16  measurement beams onto said detector element.

1       22. The interferometer system of claim 21 wherein said first beam includes a first

2  component and a second component that is orthogonal to the first component and said

3  second beam also includes a first component and a second component that is orthogonal

4  to the first component, and wherein the beam conditioner is constructed to introduce a

5  first sequence of different discrete phase shifts into a relative phase difference between

6  the first and second components of the first beam and concurrently therewith a second

7   sequence of different discrete phase shifts into the relative phase difference between the

8   first and second components of the second beam.

1        23. The interferometer system of claim 22 wherein the beam conditioner includes

2   a first phase shifter for introducing the first sequence of different discrete phase shifts

3   into the relative phase difference between the first and second components of the first

4   beam and a second phase shifter for introducing the second sequence of different discrete

5   phase shifts into the relative phase difference between the first and second components of

6   the second beam.

1        24. The interferometer system of claim 21 wherein the beam conditioner is

2   constructed to introduce a first sequence of different frequency shifts into the frequency

3   of the first beam and concurrently therewith a second sequence of different frequency

4   shifts into the frequency of the second beam.

1        25. A source beam assembly comprising a beam generation module which during

2   operation delivers an output beam that includes a first beam at a first frequency and a

3   second beam at a second frequency that is different from said first frequency, said first

4   and second beams within the output beam being coextensive, said beam generation

5   module including a beam conditioner which during operation introduces a sequence of

6   different shifts in a selected parameter of each of the first and second beams, said selected

7   parameter selected from a group consisting of phase and frequency.

1        26. The source beam assembly of claim 25 wherein said first beam includes a

2   first component and a second component that is orthogonal to the first component and

3   said second beam also includes a first component and a second component that is

4   orthogonal to the first component, and wherein the beam conditioner is constructed to

5   introduce a first sequence of different discrete phase shifts into a relative phase difference

6   between the first and second components of the first beam and concurrently therewith a

7   second sequence of different discrete phase shifts into the relative phase difference

8   between the first and second components of the second beam.

1    27. The source beam assembly of claim 26 wherein the beam conditioner

2    includes a first phase shifter for introducing the first sequence of different discrete phase

3    shifts into the relative phase difference between the first and second components of the

4    first beam and a second phase shifter for introducing the second sequence of different

5    discrete phase shifts into the relative phase difference between the first and second

6    components of the second beam.

1    28. The source beam assembly of claim 25 wherein the beam conditioner is

2    constructed to introduce a first sequence of different frequency shifts into the frequency

3    of the first beam and concurrently therewith a second sequence of different frequency

4    shifts into the frequency of the second beam.

1    29. A method of performing measurements of an object using an interferometer,

2    said method comprising:

3        generating an input beam for the interferometer, said input beam including a first

4    beam at a first frequency and a second beam at a second frequency that is different from

5    the first frequency, said first and second beams being coextensive and sharing the same

6    temporal window; and

7        by using the interferometer and the input beam supplied to the interferometer,

8    jointly measuring two orthogonal components of conjugated quadratures of fields of

9    reflected, scattered, or transmitted beams from a selected spot in and/or on the object.

1    30. The method of claim 29, wherein the jointly measuring comprises:

2        deriving a first measurement beam from the first beam;

3        deriving a second measurement beam from the second beam, wherein the first and

4    second measurement beams are coextensive within the interferometer; and

5        imaging both the first and second measurement beams on said selected spot.

1    31. The method of claim 30, wherein imaging both the first and second

2    measurement beams on said selected spot generates a first return measurement beam at

3    the first frequency and a second return measurement beam at the second frequency and

4    wherein the jointly measuring further comprises producing a combined interference

5    signal by interfering the first return measurement beam with a first reference beam that is

6    at the first frequency and by interfering the second return measurement beam with a

7    second reference beam that is at the second frequency.

1        32. The method of claim 29, wherein the jointly measuring further comprises, for

2    each of a plurality of successive time intervals, introducing a corresponding different

3    shift in a selected parameter of the first beam and introducing a different corresponding

4    shift in the selected parameter of the second beam, said selected parameters are selected

5    from a group consisting of phase and frequency.

1        33. The method of claim 32, wherein the jointly measuring further comprises:

2        for each of the plurality of successive time intervals, measuring a value of the

3    combined interference signal; and

4        from the measured values of the combined interference signal for the plurality of

5    successive time internals, computing the two orthogonal components of conjugated

6    quadratures.

1        34. The method of claim 32, wherein each of said first and second beams

2    includes a first component and a second component that is orthogonal to the first

3    component, wherein the selected parameter of the first beam is the phase of the second

4    component, and wherein the selected parameter of the second beam is the phase of the

5    second component.

1        35. The method of claim 32, wherein the selected parameter of the first beam is

2    the frequency of the first beam, and wherein the selected parameter of the second beam is

3    the frequency of the second beam.

1        36. A method of performing measurements of an object using an interferometer,

2    said method comprising:

3        generating a source beam for the interferometer, said source beam including a

4    first input beam at a first frequency and a second input beam at a second frequency that is

5    different from the first frequency, said first and second input beams being coextensive

6    and sharing the same temporal window function;

7       by using the source beam supplied to the interferometer, making a sequence of

8       measurements of an interference signal for a selected spot on or in the object, wherein the

9       making of the sequence of measurements involves, for each measurement of the sequence

10       of measurements, introducing a corresponding different shift in a selected parameter of

11       the first input beam and a corresponding different shift in the selected parameter of the

12       second input beam, wherein selected parameter is selected from the group consisting of

13       phase and frequency, and wherein each of said sequence of measurements simultaneously

14       captures information for both conjugated quadratures of fields of reflected, scattered, or

15       transmitted beams from the selected spot.

1       37. A method of claim 36 wherein the making of the sequence of measurements

2       comprises:

3       deriving a first measurement beam from the first input beam;

4       deriving a second measurement beam from the second input beam;

5       imaging the first and second measurement beams on a selected spot on or in the

6       object to produce corresponding first and second return measurement beams;

7       interfering the first and second return measurement beams with respective first

8       and second reference beams to produce a combined interference signal; and

9       making a sequence of measurements of the combined interference signal.

1       38. A method of generating an source beam, said method comprising:

2       generating an output beam that includes a first beam at a first frequency and a

3       second beam at a second frequency that is different from said first frequency, said first

4       and second beams within the output beam being coextensive; and

5       introducing a sequence of different shifts in a selected parameter of each of the

6       first and second beams, said selected parameter selected from a group consisting of phase

7       and frequency.

1       39. A method of performing measurements of an object using a scanning

2       confocal interferometer in which there is an array of pinholes, said method comprising:

3       generating an input beam for the scanning interferometer, said input beam

4       including a first beam at a first frequency and a second beam at a second frequency that is

5    different from the first frequency, said first and second beams being coextensive and

6    sharing the same temporal window function;

7         causing an image of the array of pinholes to scan across the object so that each

8    pinhole of a conjugate set of pinholes among the array of pinholes becomes conjugate to

9    a selected spot on or in the object at successive times during the scan;

10        for each pinhole of the conjugate set of pinholes, measuring an interference signal

11    value for a selected spot on or in the object, wherein the measured interference signal

12    value for each pinhole of the conjugate set of pinholes simultaneously captures

13    information for two orthogonal components of conjugated quadratures of fields of

14    reflected, scattered, or transmitted beams from the selected spot.

1        40. The method of claim 39 further comprising, from the measured interference

2    signal values for all of the conjugate set of pinholes, computing each of the two

3    orthogonal components of the conjugated quadratures of fields.

1        41. The method of claim 39 wherein generating the input beam further

2    comprises, for each of a plurality of successive time intervals, introducing a

3    corresponding different shift in a selected parameter of the first beam and introducing a

4    different corresponding shift in the selected parameter of the second beam, said selected

5    parameters are selected from a group consisting of phase and frequency, and wherein

6    each of said sequence of time intervals corresponds to a time at which a different

7    corresponding one of said conjugate set of pinholes is conjugate with said spot.

1        42. The method of claim 41, wherein each of said first and second beams

2    includes a first component and a second component that is orthogonal to the first

3    component, wherein the selected parameter of the first beam is the phase of the second

4    component, and wherein the selected parameter of the second beam is the phase of the

5    second component.

1        43. The method of claim 41, wherein the selected parameter of the first beam is

2    the frequency of the first beam, and wherein the selected parameter of the second beam is

3    the frequency of the second beam.

1      44. A method of performing measurements of an object using a scanning

2   confocal interferometer in which there is an array of pinholes, said method comprising:

3      generating an input beam for the scanning interferometer, said input beam

4   including a first beam at a first frequency and a second beam at a second frequency that is

5   different from the first frequency, said first and second beams being coextensive and

6   sharing the same temporal window function;

7      causing an image of the array of pinholes to scan across the object so that each

8   detector element of a conjugate set of detector elements among an array of detector

9   elements becomes conjugate to a selected spot on or in the object at successive times

10   during the scan;

11      for each detector of the conjugate set of detectors, measuring an interference

12   signal value for a selected spot on or in the object, wherein the measured interference

13   signal value for each detector of the conjugate set of detectors simultaneously captures

14   information for two orthogonal components of conjugated quadratures of fields of

15   reflected, scattered, or transmitted beams from the selected spot.

1      45. The method of claim 44 further comprising, from the measured interference

2   signal values for all of the conjugate set of detectors, computing each of the two

3   orthogonal components of the conjugated quadratures of fields.

1      46. The method of claim 44 wherein generating the input beam further

2   comprises, for each of a plurality of successive time intervals, introducing a

3   corresponding different shift in a selected parameter of the first beam and introducing a

4   different corresponding shift in the selected parameter of the second beam, said selected

5   parameters are selected from a group consisting of phase and frequency, and wherein

6   each of said sequence of time intervals corresponds to a time at which a different

7   corresponding one of said conjugate set of detectors is conjugate with said spot.

1      47. The method of claim 46, wherein each of said first and second beams

2   includes a first component and a second component that is orthogonal to the first

3   component, wherein the selected parameter of the first beam is the phase of the second

4    component, and wherein the selected parameter of the second beam is the phase of the

5    second component.

1        48.  The method of claim 46, wherein the selected parameter of the first

2    beam is the frequency of the first beam, and wherein the selected parameter of the

3    second beam is the frequency of the second beam.

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